The Viability of a Pure-power Ontology[1]

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Abstract:

In accounting for the objects and properties of the manifest world, issues include the fundamentality, causal efficacy and ontological robustness of the dispositional (powers, potentials, capacities) versus the non-dispositional (categorical, qualitative). Concerning fundamentality, the available options seem to be that: (i) dispositional and categorical properties are different kinds, both fundamental; (ii) dispositional and categorical properties are one and the same, and fundamental; (iii) only categorical properties are fundamental while dispositional properties, if they exist, are higher-order; and (iv) only dispositional properties are fundamental while categorical properties, if they exist, are higher-order. The viability of option (iv), a pure-power ontology, has met detracting arguments from several quarters. This paper outlines why the fourth option appears nonetheless attractive and provides a defence for its viability by suggesting how the manifestly qualitative world can be explained without recourse to fundamental categorical properties.

[1] I thank Merin Nielsen for providing the initial idea of circulating networks. I also thank Phil Dowe for his comments on drafts of this paper.

Introduction

This paper focuses on what kinds of entities are required at the fundamental level to provide a satisfactory explanation for the manifest world. Two broad categories of entities include those that are categorical and those that are dispositional. Qualitative and/or categorical properties have generally been characterised in terms of spatially-extended or space-occupying properties represented by Lockean primaries of size, shape, solidity and so on (Locke, 1924 II, Ch.VIII, 8, 66). Charles Martin, for example, describes qualitative properties as those needed for things to be perceived, providing the 'what' or 'shell' of objects (Martin, 1997, 222-223); and John Heil describes them as what individuates or differentiates powers (Heil, 2007, 84). Other descriptions view their status as 'actual' or ontologically-robust (Place, 1996), or focus on their self-containment in terms of 'completeness' in their instantiation. David Armstrong describes their nature as 'exhausted' in their instantiation by particulars, whereby they do not reserve of themselves for further interactions with other particulars (Armstrong, 1989, 118; 1997, 41, 69, 245). Alexander Bird describes them as properties that have primitive identity (Bird, 2007, 45).[2] Dispositional properties have often been contrasted to categorical properties in all of the descriptive contexts above. (The focus in this paper concerns the metaphysical difference between the two, rather than a merely predicative differentiation.)

Concerning fundamentality, the available options seem to be that: (i) dispositional and categorical properties are different kinds, both fundamental;

[2] A considerable body of literature is dedicated to teasing out the differences between 'qualitative' and 'categorical' properties, and their opposition to dispositional properties. However, this paper uses the terms 'categorical' and 'qualitative' quite generally, leaving aside more subtle distinctions. Likewise for the term 'dispositional'. To avoid the complexities relating to the ascription and counterfactual nature of dispositionality, this paper employs its ontologically-robust sense interchangeably with the term 'power'.

(ii) dispositional and categorical properties are one and the same, and fundamental; (iii) only categorical properties are fundamental while dispositional properties, if they exist, are higher-order; and (iv) only dispositional properties are fundamental while categorical properties, if they exist, are higher-order.

In Part 1 of this paper I explore the first three of these broad positions by utilising representative cases for each. The first option is a dualist conception of properties represented in this paper by an examination of the New Essentialist approach of Brian Ellis. The second option is representative of the Identity Theory of Properties discussed by Charles Martin and John Heil. The third option is encapsulated in David Armstrong's Categoricalism.

I argue that, in light of the problems that inhere in the first three of these options, the fourth appears attractive. Nonetheless, there has been considerable criticism of this Strong Dispositionalism, including the regress arguments outlined and discussed by Bird (Bird, 2007, 99-146). Part 2 of this paper specifically focuses on the Swinburne and neo-Swinburne regress arguments which together assert that, without fundamental categorical properties, pure power theories are unable to account for the ostensibly qualitative world. I answer this charge by providing a counterexample that describes how the manifestly qualitative world might be explained without recourse to fundamental categorical properties.

Part 1: Fundamental categorical properties

What follows is a brief examination of Dualism, the Identity Theory of Properties, and Categoricalism.

1. Dualism

Option (i) is exemplified by dualist theories such as New Essentialism, advocated by Brian Ellis[3] (Ellis, 2001b, 2002), in which dispositional and categorical properties represent distinct kinds of fundamental entities. Although both types of property are mutually exclusive in terms of the categorical being structural and the dispositional being non-structural (Ellis, 2002, 70), fundamental categorical properties (or dimensions) play a causal role in the operation of powers (Ellis, 2001b, 9-10; 2005, 470). This role is to direct how the effects of causal power are distributed (Ellis, 2001a, 2008). When a causal process occurs, the effect is to change the value of certain dimensions, and Ellis describes these dimensions as 'respects in which things may be the same or different' (Ellis, 2008). These dimensions include, for example, quantities, size, shapes, duration, direction, spatiotemporal separation, position and time (Ellis, 2001b, 136-138; 2008). They are 'presupposed' by the causal powers and are thus fundamental (Ellis, 2008). Nonetheless, the causal powers, capacities and propensities of the fundamental natural kinds are not reducible to the dimensions (Ellis, 2001b, 138; 2005, 470). Rather, they are, themselves, also fundamental (Ellis, 2001b, 128). For now I will put aside questions concerning how fundamental properties can be ontologically dependent upon other entities for their existence, as Ellis seems to propose (2001b, 138, 218; 2002, 70; 2005, 470-471). Instead, I concentrate on what is described overall: Fundamental categorical and fundamental dispositional properties[4], both irreducible to the other, but which share a dependency

[3] First posited jointly with Caroline Lierse (Ellis & Lierse, 1994).
[4] Causal powers are properties involved in physical causal processes and energy transmission. Capacities and potentials are dispositional properties, but do not necessarily involve transmission of energy (Ellis, 2008).

relationship such that the categorical dimensions specify the range of effects wielded by the causal powers, and are 'presupposed' by them.

Importantly, it is the constraint imposed by the dimensions—the fact that they are respects in which things can or cannot change—that presumably provides their identity as structural properties, and thus, as categorical. But this is compromised by the fact that Ellis also considers the causal powers and capacities to be dimensions. His reasoning is that, like categorical dimensions, causal powers and capacities also represent 'respects in which things can be the same or different' (Ellis, 2008).

Given that both dispositional and categorical properties represent dimensions, being a dimension *per se* does not render a property categorical. So, if not the fact of *being* a dimension, what does determine the difference between Ellis's fundamental categorical and fundamental dispositional properties? Ellis claims that categorical properties are quiddistic in the sense discussed by Bird and Robert Black, in that they have some 'nature' independent of their causal roles (Bird, 2006; Black, 2000; Ellis, 2002, 70; 2008). So although the fundamental properties do play a causal role (Ellis, 2005, 470), what supposedly provides them their identity *as* categorical is something over and above that role.

Hence, on one hand, their identity is given apart from their causal role, by what they are rather than by what they do. On the other hand, it is only in virtue of their causal role that we can recognise these categorical properties, since, as Ellis notes, if they had no ability to engage in a causal process leading to our perception of them, we could not know anything about such categorical properties (Ellis, 2001a). The role these categorical dimensions play, as 'pure forms of physical structure', is to restrict, constrain and inform the kinds of effects that causal powers can wield (Ellis, 2002, 174). Ellis suggests that things possess categorical dimensions which change in response to the action of causal powers. These changes, together with our innate capacity to learn from experience about the pattern of distribution of these causal powers (Ellis, 2008), allows us to infer the existence of the categorical dimensions. Hence, the *recognition* of categorical properties depends at least partly on their causal role.

It can be argued that a deep inseparability of the quiddity and causal role of categorical properties exists. Let us suppose, as suggested by Ellis, that the role of categorical dimensions is to constrain and direct causal power by limiting how they, themselves, can be changed. In this case, how the change can or cannot occur, and thus what the causal powers can or cannot do, seems 'built-in' to what the dimensions, themselves, *are*. The situation is not remedied, but instead exasperated, by the fact of their causal role being inextricably tied to their ostensible quiddity, since it appears to render the very 'structural nature' of the dimensions as essentially powerful.

Ellis explains that change occurs via laws of action and reaction, these laws defined as the 'detailed specification' of the categorical dimensions (Ellis, 2005, 470); descriptions of the essential nature of natural kinds (Ellis, 2002, 59). However, relying on the laws of action and reaction, to explain why or how the dimensions change as they do, does not rescue the dimensions from being essentially dispositional. On one hand, if the essential nature of the dimensions is quiddistic, an explanation is lacking for why the laws, as specifications or descriptions of these categorical dimensions, should or could bring about changes. On the other hand, if the laws entail changes in accordance with some nature of their own or in virtue of the nature of causal powers, then the causal role of the categorical properties is over-determined—occupied by the laws. Remedying the overdetermination by removing the causal role from the categorical dimensions re-admits the difficulty of how the categorical dimensions may be perceived or discerned in the first place. Armstrong has argued the incompatibility of categorical properties and necessary laws. ‘It looks as though these structural properties must have some “causal role”’, he writes, ‘And will they not have that role contingently only? Not being powers, they do not necessitate any particular causal role’ (Armstrong, 2001; Ellis, 2002, 170).

Given the difficulty in providing a purely quiddistic identity for the categorical dimensions, might it not be better to bite the bullet and claim them as fundamentally powerful? This is the idea behind Bird’s (Bird, 2005a; 2007, 161-168) and Stephen Mumford’s (Mumford, 2004, 188) suggestion that the claim for fundamental structure being categorical may be merely a matter of theoretical perspective. They observe, for example, that classical accounts, that treat spacetime as ‘background’, contribute to the assumption that structure is categorical. Considering distance in Newton’s Law of Gravity: $F = Gm_1m_2/r^2$, Mumford suggests that the force could be a manifestation of spatial separation just as readily as a manifestation of the respective masses, since the equation itself makes no distinction between what is categorical and what is dispositional (or powerful). The quantised field of Quantum Mechanics side-steps the relational spacetime of General Relativity in favour of returning to an absolute frame of reference for spacetime, also contributing to the idea that if spacetime is quantised at the fundamental levels, such ‘structure’ must be considered in terms of some kind of fixed background. However, as Bird notes, a concept of spacetime as a fixed geometry and metric leads to the idea of structure at fundamental levels being passive rather than active, and thus to claiming spacetime structure as categorical rather than powerful (Bird, 2005a, 458). However, times are changing and theoretical perspectives with them. Much of the recent theorising behind quantum gravity research has been driven by the recognition that providing a background-free geometry is vital to successfully uniting the gravitational force with the electro-weak and strong forces at some fundamental level (Bilson-Thompson, 2005; Bilson-Thompson et al., 2009; Bilson-Thompson et al., 2007; Smolin, 1997, 2000, 2006). These theoretical models imply that fundamental structure *can* be given in relational, or purely powerful, terms.

In light of current scientific endeavours, there is good reason to suggest that structure is itself powerful. Meanwhile, the argument Ellis provides for holding fundamental structure to be categorical is largely to satisfy the demands of the Swinburne regress argument. As I will argue in Part 2 of this paper, however, it is not transparent that the ostensible qualitative world requires the existence of fundamental categorical properties.

2. Identity Theory of Properties

Recognising the difficulties incurred by positing two distinct types of property at the fundamental level, Charles Martin (Martin, 1993, 1996b, 1996c; 1997, 216; Martin & Heil, 1999) and John Heil (Heil, 2003, 111-112; 2005a, 2005b), attempt to *identify* the two. Couching the identity in language that downplays the mutual exclusivity of the traditional dispositional and categorical dichotomy, they replace the term 'categorical' with 'qualitative' (Heil, 2003, 111-112). Martin posited an earlier version of the theory—known as the Limit or Dual-aspect Theory—which he later clarified in terms of the Identity Theory of Properties. This theory utilises the idea of fundamental ‘power-qualities’, which are at once qualitative and powerful (Heil, 2003, 2005b; Martin, 1996c, 136; 1997). Like an ambiguous drawing (Martin, 1997, 216-217), or a Necker Cube (Heil, 2003, 120), the qualitative ‘face’ or ‘side’, respectively, provides the ‘shell’, and the dispositional ‘face’ or ‘side’ indicates what the bearers of these power-qualities ‘do’. Importantly, whether the power-quality appears categorical or dispositional will depend on how we ‘differently consider’ it (Heil, 2003, 112).

2.1 Dual versus Single Natures

The possibility of two viable ways to consider a power-quality leaves the impression that neither the dispositional nor the qualitative can be abolished. They thus appear as two different ‘natures’ (Sparber, 2006), each uniquely contributing to the world. The uniqueness of the contribution is evidenced by the criticism that Martin and Heil make of the monist theories of Armstrong and Shoemaker—criticism on the grounds that each fails to supply something crucial of the dispositional and qualitative respectively (Heil, 2003, 76, 111-112, 120; 2005a, 352-353; Martin, 1996c; 1997, 213-216; Martin & Heil, 1999, 47-48). Purely non-qualitative worlds, for example, those in which relations and relata are interdependent (Heil, 2003, 104), deny room for the counterfactual nature of dispositions. They thereby require the reduction of possibility to the merely epistemological (Heil, 2003, 99-113). Like Ellis, Heil and Martin draw on the Swinburne regress argument, suggesting that a world that has no fundamental categorical properties would not provide enough conceptual resources to allow us to experience the manifestly qualitative world of objects with shapes, size, motion, solidity and so on (Heil, 2003, 98; Martin, 1997, 222-223). The claim for qualitative properties relies on the premise that even if properties like shape, position, duration, divisibility and solidity, of themselves, could be accounted for dispositionally, then the qualitative would still be required with respect to how these properties are detected. Importantly, this claim indicates that the dispositional lacks something which is provided by the qualitative.

Purely qualitative worlds are also criticized on the ground that they lack modality (Martin, 1993; 1996a, 174-177; 1996c, 127-129), would be undetectable (Heil, 2003, 118) and overdetermine the role of dispositions because the qualitative properties and/or laws do all of the causal work. Here we have the converse of the above: the qualitative lacks something which is provided by the dispositional.

It can be nothing other than supposing that the dispositional and categorical each bring something unique to the world that fuels Martin's and Heil's criticism of monist stances which each lack either the qualitative or the dispositional. They assert that the qualitative and the dispositional are both required to adequately explain the manifest world (Martin & Heil, 1999, 47). Since there is something unique about each, it would seem that the two cannot be of the very same nature. This is particularly the case since the dispositional and qualitative are claimed to be equally basic, intrinsic, and irreducible to each other (Heil, 2005b; Martin, 1996c, 132-133; Martin & Heil, 1999, 48). This pushes in the direction of a robust distinctness, but the Identity Theory denies such a distinction. The strict identity (Heil, 2003, 111) of the dispositional and categorical indicates that the two are really a unitary 'one and the selfsame property' that cannot be prised apart (Martin, 1997, 216).

Assertions that the qualitative and dispositional are one and the self-same property raises the issue of the seemingly unique nature of each. In particular, when we differentiate between the categorical and dispositional in our consideration process, do we distinguish between them in virtue of some ontologically-robust feature that is either built into either the property itself or the physical context of the property; or do we make the distinction merely in virtue of the way we perceive the property? That is, does our ‘differently considering’ power-qualities in terms of qualitative or dispositional reduce to epistemology? In their discussion on picture theory (Heil, 2007; Martin, 1997, Heil, 2003 #1386), both Martin and Heil deny this claim, insisting that there is some truthmaker that underpins the fact of the different ways we can consider properties.

Whatever this truthmaker might be, if there is something in the property itself which leads us to differentiate the qualitative from the dispositional, then clearly each contributes uniquely to producing different effects in a perceiver, belying the claim that the two are identical.

If not something in the property itself, can the truthmaker be found in the physical context in which the property (or more correctly, the property-bearer) subsists? Martin could be read as heading in this direction when he writes: ‘The physical environment and the individual human mind should be considered to be reciprocal disposition partners for the mutual manifestation of perception’ (Martin, 1997, 213). This option suffers from the same difficulty as the above; namely, it falls short of explaining why the same physical context should allow the self-same property to be perceived in two completely different ways.

Can differing functional roles, *pace* Stephen Mumford (Mumford, 1998) then, explain why we differentiate the dispositional and qualitative dependent upon how we consider the power-quality? Depending upon the reference to a property’s functional roles, we appropriate one term or the other. Accordingly, whether considering a property to be qualitative or dispositional at any point in time will be closely tied to the function upon which we are focused at that time. If the focus is on, for example, how one property is individuated from another (e.g. sphericity from bigness), then the property is viewed as qualitative. The very same property can be considered dispositional when referring to its function of bestowing power on its bearer (e.g. in virtue of being spherical, a ball can roll). I argue, however, that indexing qualitativity and dispositionality to difference in function still leads back to the same difficulty in explaining why one and the same property gives rise to two different functional roles.

The power-quality described in the Identity Theory is not some complex or conjoint property. (A dual-aspect theory would face Armstrong's criticisms concerning how the two are joined together in a property (Armstrong, 1997, 83-84).) So in principle, the unification of the dispositional and qualitative into such a property seems to present a monist position. However, accepting the contributions of the qualitative and the dispositional as unique raises questions concerning how to then explain and justify their purported strict identity.

2.2 Non-relational Dispositionality

The identity of the dispositional and qualitative in the power-quality implies the imposition of the qualitative upon the dispositional; and since the qualitative is intrinsic and non-relational, so too must be the dispositional. The non-relational status of dispositions is consistent with the separation of dispositional properties from their manifestations (Heil, 2007, 83). However, it also raises the question of how these dispositions might differ from Armstrongian-style categorical properties ('pure-qualities'). Power-qualities are similarly self-contained, wholly-present, intrinsic, and distinct from the (contingent) relations that allow them to manifest.

In the case of complex objects, each constituent part bears dispositional properties, the manifestation of which contributes to the overall dispositional profile of the complex object (Heil, 2007, 84). The dispositional properties of each constituent part are separated from their manifestation-relation; likewise each resulting disposition. Proposing a distinctness between relations and dispositional properties removes the possibility of necessary connections between dispositions and their manifestation. For Heil, this lack of necessity applies both within and between complex objects. Although Martin and Heil are proponents of irreducible dispositionality, their contingent relations between properties seem to disallow it. Fundamental, irreducible dispositionality appears to go hand in hand with necessary relations which are continuous with each other via relations, or, in Ellis's words, dispositional properties that 'stretch out' (Ellis, 2001b, 267). By ruling out dispositional properties that are continuous with their manifestation, the Identity Theory of Properties is under a burden to explain how non-relational power-qualities differ from pure-qualities, for both appear to rely on contingent relations at the fundamental level.

Heil's answer draws on considerations of simplicity. Pure-qualities (if they exist) require contingent laws of nature linking them. Together these categorical properties and laws would bestow power on the property-bearers. In contrast, Heil's power-qualities do not require contingent laws to bestow power, doing so through their own natures (Heil, 2003, 79) whose powers are 'built into' them (124). As I have just argued, however, it is unclear how non-relational power-qualities do bestow power upon their bearers by their own nature, if their dispositions require contingent links between the dispositional properties.

Heil claims that the ability for dispositions to bestow power is a brute fact (117). Nonetheless, he claims that this is no more mysterious than competing views, arguing that his position has the advantage over Categoricalism because his requires only a single brute fact—that 'power-qualities bestow power on their bearers'—whereas Armstrong presents both categorical properties and the laws of nature linking them, entailing at least two brute facts (117). As mentioned already, however, Martin and Heil also require an additional (contingent) relation to link dispositional properties.

Because Martin and Heil defend the existence of irreducible dispositionality, their thesis demands some explanation of how this irreducible dispositionality cashes out in terms of its power-qualities. If the difference between power-qualities and pure-qualities lies in the ability of power-qualities to bestow power without contingent laws of nature, then some detail of the action of 'bestowing' is required. Otherwise the theory presents essentially a deus ex machine, leaving the notion of power-qualities incomprehensible.

3. Categoricalism

In contrast to New Essentialism and the Identity Theory of Properties, Armstrong's categorical monism restricts the domain of 'real' properties to the purely categorical. Objects participate causally in the world by means of dispositional properties that supervene upon the categorical microstructure of their object-bearers. This supervenience, according to Categoricalism, depends upon prevailing, contingent laws of nature. Armstrong also defends a view of strong causality according to which connections exist between instances of cause and effect that, being instances of nomic types, amount to more than Humean regularities. Such a view faces the challenge of explaining where the necessity required of strong causation arises in a world devoid of irreducible dispositional properties.

One explanation may be found in the idea that Categoricalism, being a 'soft theory of powers' (Armstrong, 2004, 142), provides for the necessity via the laws of nature. Singular causation occurs between instances. Armstrong defines this as a certain state of affairs (the cause) bringing about a further state of affairs (the effect) (Armstrong, 1997, 218) via law-governed singular causation. Being law-governed, singular causation is not 'mere regularity' (Armstrong, 1997, 218). Since it is governed by relations between universals (repeatables), it is also nomic (Armstrong, 1996b, 102). However, 'lawful singularity' is subject to a trilemma, as outlined by Armstrong (Armstrong, 2004, 128):

(1) Singular causation is a relation 'intrinsic to its pairs'(strong causation)

(2) Singular causation is essentially law-governed

(3) Laws are essentially general

If singular causation is intrinsic (1), then it is local to the relata. But, by (2) and (3), law-governance indicates that this local relation is part of a wider system, so it cannot be strictly local. The problem is that causal relations link particulars (locally), but laws link universals (non-locally).

Armstrong's solution draws on the repeatability of universals (properties) such that connections exist between instances as well as between higher-order state-of-affair types (Armstrong, 2004, 130, 133-134). Whereas the surface form describes connections between token events, the actual form is a connection between *kinds* of events, such that a law holding between states of affairs (instances) is really a causal connection between kinds (Armstrong, 2004, 134). Causal relations between instances of universals instantiate these higher-order laws but do not *themselves* constitute laws (Armstrong, 1997, 227). Because instances are instances of *kinds*, we may infer existence of laws via experience of the instances. But there is more than merely inferring from instances to laws. Ontic relations between the kinds *ensure* the relations between instances, with such necessitation supposedly provided by the laws. This would seem to make the laws, as relations between kinds, responsible for necessity. Yet, these laws do not exist over and above their instances, which would seem to make the relations between instances responsible for the necessity required for strong causation.

The apparent bootstrapping effect that emerges in this theory concerns some critics of Categoricalism, including Charles Martin Herbert Hochberg and Alexander Bird, who each argue that Categoricalism cannot successfully derive the required necessity. Martin focuses his criticism on the idea that laws ultimately supervene upon the relations between instances. According to Martin, necessity is inadvertently introduced into Armstrong's Categoricalism via repeatability and thus connectability; these being ascriptions of irreducible dispositionality. Hochberg and Bird argue that reliance on laws as relations between kinds is untenable; and that passing responsibility back and forth between the instances and the kinds, although resulting in the *appearance* of necessity, actually fails to account for it.

3.1 Martin's Argument Concerning Connectability and Repeatability

In *Dispositions: A Debate* (Crane, 1996) Armstrong describes the role of the laws thus:

> Let us now apply such a scheme to the case where a brittle glass is struck, and as a result shatters. The striking of the as yet unbroken glass may then be thought of as the instantiation of a very complex universal which, because there is a certain forward linking of universals, brings forth the glass in a shattered state (Armstrong, 1996a, 46).

This 'connecting' or 'forward linking' of universals indicates to Martin that Armstrong sequesters something 'in' the first-order properties. The grounding of dispositional properties in categorical properties depends heaviliy on: i) properties being repeatables; and ii) repeatables forming regularities in virtue of being repeatables. Because property universals are repeatables, the relations between their instances will form a pattern, *the same relations between the same universal instances.* As Armstrong notes, 'we can say that an *F*, simply in virtue of being an *F*, will bring forth a *G*' (Armstrong, 1996b, 100). Martin (Martin, 1996a, 174-177; 1996c, 127-129) argues that Armstrong's laws are strong and thus capable of ensuring the connections between the instances; but that the necessity built into Armstrong's system cannot be accounted for in terms of purely categorical properties and relations. Although not explicitly recognised, there is irreducible dispositionality present in Armstrong's ontology. Given that: i) the same universals will be linked in the same way each time; and ii) these links are external to the first-order properties that are their relata, Martin asks what makes the same links instantiate between the same properties each time? The answer seems to be that the properties are repeatables; but this indicates that it must be something 'in the properties' themselves that affords them to link repeatedly the same way each time. Yet, it cannot be 'in' the properties *unless the properties are not distinct from the laws*, in which case they are not 'self-contained', categorical properties. Thus, to rely on the repeatability of universals is to admit irreducible dispositionality into the ontology.

3.2 Hochberg's Criticism of N: Reliance on Ambiguity

Armstrong's relation of natural necessity, 'N', is described by Hochberg as occurring where, 'a primitive higher-order causal relation between universals naturally entails corresponding specification' (Hochberg, 1999b). When holding between two universals (or more correctly, two state of affairs types) F and G, we write N(F, G). But as Hochberg notes, Armstrong sees this as a higher-order state of affairs (Hochberg, 1999b, 485). Hochberg means that Armstrong's laws are relations both between *token* atomic states of affairs (i.e. 'this F' and 'this G') and simultaneously between types of states of affairs ('F' and 'G'). But Hochberg denies the logical possibility of the latter case if F and G do not exist except in their instantiations. Armstrong writes that laws 'exist nowhere and nowhen except in their positive instantiations' (Hochberg, 1999b, 239). There can exist, in ontologically-robust terms, a *totality* of token states-of-affairs of particular kinds. However, no such corresponding ontologically-robust state-of-affairs-type can exist if, as Armstrong proposes, laws exist only in their instances. The upshot is that there can exist an ontologically-robust relation between 'this F' and 'this G', but not between F and G; the relation between F and G as *types* can be only an abstraction from the totality of relations between instances.

Hochberg notes Armstrong's claim that, because a relation between *instantiated* universal instances—higher-order or otherwise—is a state of affairs, laws are simultaneously both instantiated constituents of states of affairs and dyadic universals acting as 'functors', combining two universals to form another complex universal (Hochberg, 1999b, 485). For Hochberg, construing laws in both these ways is 'misusing' N by relying on its ambiguity to achieve an illusory goal:

> Fusing these distinct roles of the causal connection N, Armstrong has N(F,G) as a fact, a Husserlian law of nature that is the ontological ground for 'all F's are G's' stating a causal law, as opposed to an accidental generality, *and* as a property that is exemplified by particulars. This ambiguous use of N enables him to achieve the specification to a first order generality and its instances. But, like Husserl, he can provide no account of the entailment involved in deriving the universal generalization' (Hochberg, 1999b, 486).

In truthmaker terms, we could take either a bottom-up or top-down approach. The bottom-up approach would let instances act as ultimate truthmakers for successive higher-order levels of instances and relations. In this case, a first-order relation, F*a*RGa, instantiating the law, N(F,G), serves as truthmaker for its own necessity, since the law supplying this necessity supervenes upon these first-order instances. Relations between instances also act as truthmakers for the necessary relations between instances (and higher-order instances) of types. But it is unclear how regularities of instances can act as truthmakers for something stronger than mere regularity.

The top-down approach would allow that, although we *infer* the existence of types via instances, the same types ensure the existence of the relations between instances. This approach appears, superficially, to solve the lack of necessity in the bottom-up approach. However, as pointed out by Hochberg, understanding types other than as abstractions from the totality of instances belies the claim that laws do not exist over and above their instances. If *ontologically-robust* relations between *types* do not exist, then they cannot be posited as ultimate truthmakers for the supposed necessity of the relations between instances. This would require a regress of higher- and higher-order instances of F and G to be truthmakers for lower-order relations, reaching no actual F and G existing apart from their instances. N(Fx, Gx) relies on a higher-order necessity holding between instances of universal types N (F, G), which relies on further higher-order necessity, passing on the burden of explanation *ad infinitum* (Hochberg, 1999a, 254).

Hochberg argues that Armstrong's apparent necessity is an illusion born of juxtaposing the bottom-up and top-down approaches (Hochberg, 1999a, 244-274; 1999b, 486-488; 2001, 299-317), producing a truthmaker for neither the relations between instances, independent of the higher-order laws; nor for types, independent of relations between instances. In Hochberg's view, the law instances, the law regularity, and the law necessity must be treated separately, rather than as a fused notion. This means separating N(Fx, Gx) as a higher-order fact; N(Φx, Ψx) as a higher-order relation between universals; N(Fx, Gx) as a first-order universal that "contains" the relation N(Φx, Ψx); and N as a functor forming the universal from Fx and Gx (Hochberg, 1999a, 258-260; 1999b, 486; 2001, 301-303). However, this separation would require amendments to Armstrong's laws. The next section outlines Bird's formal characterisation of what kind of revision would be required, and why he believes that it would not be achievable within the framework of Categoricalism.

3.3 Bird's Formal Characterisation

Bird's argument follows from a summary of Armstrong LAWS (Armstrong, 1983, 1997):

> LAWS: Laws of nature are contingent relations among natural properties (Armstrong 1983). If F and G are first-order universals, then a law relating them is the fact of a certain second-order universal relating F and G. We may call that second-order relation 'N', so that the law may be symbolized N(F,G). N has certain properties. For example: N(F,G) entails $\forall x(\mathrm{F}x \rightarrow \mathrm{G}x)$. Let us call the relation between F and G that holds whenever $\forall x(\mathrm{F}x \rightarrow \mathrm{G}x)$ the 'extensional inclusion relation', symbolized thus: R(F,G). So N(F,G) entails R(F,G). However, R(F,G) does not entail N(F,G), since the relation of necessitation is not the same as nor coextensional with the relation of extensional inclusion. This is clear because there may be accidentally true generalizations without any corresponding law (Bird, 2005b, 147-148).

Bird's formal characterisation of Armstrong's N:

(I) $\langle$N(F,G) entails $\langle$R(F,G)$\rangle$

where N(F,G) is the relation of necessitation and R(F,G) is the extensional inclusion relation between instances. (I) tells us that wherever there is a necessitating relation, there is a relation. A general law, Armstrong's relation between states of affairs types is just such a necessitating relation. N possesses a modal property, namely *entailing*, but because there might be accidental relations between instances of F and G, we also have:

(II) ⟨P(F, G)⟩ does not entail ⟨R(F,G)⟩

where P(F,G) is a second-order relation that holds between F and G wherever possession of F raises the chances of G. Armstrong's properties and relations, however, are categorical states of affairs and hence have no modal qualities. Being a second-order *relation*, P is, like all properties and relations in Armstrong's ontology, categorical. As such, P does not necessitate G. If both N and P are nothing over and above their instances, then there is nothing to distinguish N from P, which are equally relations between instances. But N does necessitate G while P does not. We need an explanation for the necessitation in one and the lack of necessitation in the other.

The problem might be remedied, suggests Bird, by considering both (I) and (II) modal or non-modal. He offers two modifications, albeit observing that neither is satisfactory:

(I*) ⟨N(F,G)⟩ (merely) implies ⟨R(F,G)⟩

and (I**) ⟨N(F,G)⟩ (contingently) necessitates ⟨R(F,G)⟩.

The (I*) modification drops entailment between the necessitating relation and the extensional inclusion relation, leaving Armstrong with only a regularity theory of laws rather than a causal theory of strong laws, which would be unacceptable to him. The (I**) modification makes N only contingent necessity. It provides a kind of necessity, but disallows entailment, dictating merely that a relation between this F and this G is necessary, given that the relation between F and G is necessary. Letting (I**) be represented by N' (N,R), as Bird notes, N' is then ‘something which explains, if N' (N,R), why whenever N(F,G) - and indeed makes it the case that N(F,G)’ (151). But N' is a higher-order analogue of N, and requiring a still higher analogue—N''—to explain N', requiring a higher analogue *ad infinitum* (Bird, 2005b, 151). Hence we get the same regress identified by Hochberg.

The theory of strong laws required by Armstrong’s Contingent Identity Thesis has proved to be problematic in terms of necessity, as discussed by Martin Hochberg and Bird. The repeatability of universals seems to implicitly invoke irreducible dispositionality in some form or other. Laws that are exemplified by necessary relations between instances would have truthmaker support in virtue of the necessity proposed at the instance-level. Necessary relations could exist only by virtue of irreducible dispositionality among the relata, ruling them out as categorical. However, laws consisting only in a totality of single instances require independent explanation for their existence if they are to warrant the instances of which they are comprised. Such independent explanation does not seem to be available in terms of higher-order types without postulating some end-point, perhaps like the transcendent Platonic ideal type, which is not legitimately categorical.

Part 3: Pure power theories and regress arguments

Thus far I have pointed out difficulties that arise when accommodating the existence of fundamental categorical properties, as required by the Swinburne regress and neo-Swinburne arguments. New Essentialism proposes the existence of fundamental categorical properties whose identity is given in terms of the quiddity. However, the inability to tease out what these properties are from what they do in terms of both their causal role and their recognisability compromises their status as categorical. The difficulties that the Identity Theory of Properties faces resemble, in principle, those that other dual theories encounter; namely, the theoretical assumptions are informed by the dichotomy that underpins the concepts of the categorical and dispositional. Moreover, an explanation for how power-qualities significantly differ from Armstrongian pure-qualities is required to justify how irreducible dispositionality operates within the theory. Categoricalism is under the burden to provide an adequate account of the necessity it calls upon for strong laws, without building irreducible dispositionality into its fundamental properties. The challenge for Strong Dispositionalism is to answer the Swinburne regress by giving an account of how the manifestly qualitative world might be explained without recourse to fundamental categorical properties.

The aim of the next section is to shore up the position of the pure-power theorist by providing a counterexample to the Swinburne regress arguments that something categorical is required in order to achieve the qualitative world.

3.1 Light-like Networks

Traditionally, power has been assumed to require a categorical bearer in the form of some particular (or qualitative field) which acts in virtue of its power (Armstrong, 1997, 69, 204-205; Martin, 1997, 197). The positions discussed thus far all hold that properties which bestow power to particulars depend in some way on the categorical.

The underlying impetus for asserting that powers require bearers comes from the notion that there must be some categorical space-occupier that is the recipient or antecedent of the action (or effect) of power. Given this traditional background, power is understandably defined (in metaphysics) as the ability that a property *bestows upon its bearer* to affect or be affected (Armstrong, 1997, 69).

Suppose the universe to be, however, a field of power, neither borne by categorical entities nor grounded in categorical properties. In this context, we may envisage the fundamental entities to be light-like processes that can exist in the form of subluminal speed networks. I will refer to this idea—just for the sake of convenience—as Light-like Network Theory. (This is not intended as a model of the actual world. Rather it offers a plausible account of categoricity in the manifest world, starting from a pure-power base.)

3.1 Primitives

In Light-like Network Theory, the basic ingredients are force carriers[5] (or conceivably 'bits of force' or more technically, gauge bosons or field fluctuations) which always travel at the speed of light and are not spatiotemporally bordered. The Standard Model of particle physics describes four types[6] of gauge boson: photons (involved in the electromagnetic force), W and Z bosons (in the weak interaction), gluons (in the strong interaction) and gravitons (possibly involved in gravity[7]).

[5] In referring to 'individuals', 'entities' and 'particles', I use the terms loosely, since I reject the notion of strict particle-hood.
[6] Actually, there are fewer than four, since the weak and electromagnetic forces have been shown to be different forms of the same, and it is posited that all the forces will eventually be resolved into one.
[7] Although not directly detected at this time.

Since the worldlines of force carriers correspond to a spacetime interval of zero, they are neither continuously space filling nor persistent.[8] Despite generating all of the hallmarks of the categorical, these force carriers fulfil the criteria of pure power.

In addition to force carriers, we could regard spacetime's dimensional topology (incorporating length, breadth, height, time and how they interconnect) as a primitive. In our everyday experience, each spatial dimension represents an arbitrarily orthogonal direction of displacement. The existence of more dimensions would involve the availability of further orthogonalities.

Let us suppose, then, that the universe has a topology of both 'open' (e.g. length, breadth and height) and 'closed' (curled up or compacted) spatial dimensions, such that force carriers traverse more than the three everyday spatial dimensions, travelling also in the microscopic curled up dimensions. These are conjectured to constitute a built-in (although dynamic), micro-topology at every point in macroscopic space.

Since Light-like Network Theory treats dimensionality as fundamental, it is important to note that spacetime is not categorical in any sense of 'bordering off', 'directing' or 'containing' power in the way that structure is portrayed in New Essentialism. Everyday dimensions, for instance, do not border off motion but facilitate it via three orthogonal directions. Motion among compacted dimensions would be likewise unbounded, and likewise in accord with local spacetime curvature, which is affected by the movement.

[8] Indeed, there is no absolute fact as to how much spacetime is involved between occurrences of the absorption and emission events pertaining to the transmission of force, since this varies with the frame of reference. The extension of such worldlines can be *invariantly* characterised, however, in terms of 'action', whose units are those of Planck's constant.

Navigating this labyrinth, force carriers may continually end up where they began in relation to some frame of reference, all the while penetrating the curled up dimensions, depending on their quantum mechanical properties (e.g. wavelength, spin, colour).

While it is initially useful to *talk* of field fluctuations being separate from the dimensional topology, they can be regarded as not strictly distinct. Rather, the dimensional orthogonalities together with field fluctuations could be inter-dependent and dynamically overlapping as each force carrier induces geometric curvature, modifying the range of orthogonalities 'available' to itself and others.[9]

Consider, for example, a convergence of photons that increases the energy density in some region. The consequently greater gravitational curvature changes how photons may be absorbed and emitted by that region. In this picture, spacetime structure is interdependent and to some degree interchangeable with gauge-boson activity. That is to say, the underlying field structure of intrinsic orthogonalities and the quantisable field features (gauge bosons) are not metaphysically distinct;. Thus, we might conceive of spacetime's local topology as the primitive effect of field fluctuations interacting with each other. The relevant orthogonalities exist only in that they correspond to possible trajectories associated with force carriers; correlating to a range of available pathways within the topology of the compacted dimensions. Indeed, the conservation of lepton and baryon numbers is suggestive of inherent dimensional 'knotting' within such a microtopology.

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[9] We might do better to think of the topology in terms of 'metric-topology', such that the topological discussion is understood in mathematical terms. However, this would be merely a matter of instrumental convenience. As far as furniture of the world is concerned, we can treat the topology and the energy of the system as essentially a unity.

Conversely, the typology of force carriers may correspond to the differentiation of *properties* by topological orientation. Consider a field fluctuation, for example, moving exclusively through macroscopic 3-space as an oscillation of electromagnetic field components. This may represent a geometric or topological fluctuation in some compacted space orthogonal to the vector in 3-space. Such a fluctuation may have several simultaneous, independently variable orientations with respect to both 3-space and the 'labyrinth' of compacted spaces. Absorption and emission by the compacted dimensional micro-topology would be a matter of force carriers changing trajectory whereby their orientations, corresponding to physical quantities, are conserved.

Possible objections include that the close inter-dependence of the topology and force carriers sounds like a circular definition. This is unavoidable when talking about fundamentals since there is no way to describe them in terms more basic than themselves. But it is an acceptable, informative circularity rather than vicious, since it emphasises non-distinctness of the fundamental. Subject to scientific investigation, the dimensional topology and the field fluctuations could be mutually tailoring, each representing power rather than categorical constraint. A physical manifold naturally has both topological and geometrical aspects, where the latter may pertain to force carriers. Importantly, the close interaction of the force carriers and the topology supports a view of structure as powerful rather than categorical.

3.2 Networks

Let's imagine, say, many gauge bosons coinciding in the micro-topology at the same macroscopic location. Although the gauge bosons travel at the speed of light and do not have rest mass, they form a self-sustaining network that on whole appears ‘massy’, travels at less than the speed of light, and supports, as higher-order phenomena, the qualitative properties of the manifest world.

The networks have rest mass in a way analogous to black holes having greater rest mass thanks to photons that they have absorbed. The emission or absorption of gauge bosons, involving ‘excited’ states of the networks, may occur in terms of competing energy density arrangements. Likewise, virtual particles may appear for short durations of time (within the constraints of the Heisenberg Principle), in the form of disturbances (Davies & Gribbin, 1992, 230-231).

So we can speculate that field fluctuations moving through the open dimensions (3-space) are absorbed and emitted as they enter or exit circulating networks of ‘sibling’ gauge bosons, which, based on geometry and/or topology, demand quantisation of their properties. As Gribbin describes it, a photon can be pictured as a ripple in the fifth dimension, a W boson might be a ripple in the 6th, a Z boson in the 7th and so on, including combinations (Gribbin, 2007, 105-106).

A ‘barber pole effect’ illustrates how networks offer an explanation for massiness, even though the constituent force carriers travel at the speed of light and thus lack rest mass. (Stationary networks would be represented by a vertical barber pole in this figure).

Figure 1: 'Barber Pole' Compared With Gauge Boson Path[10]

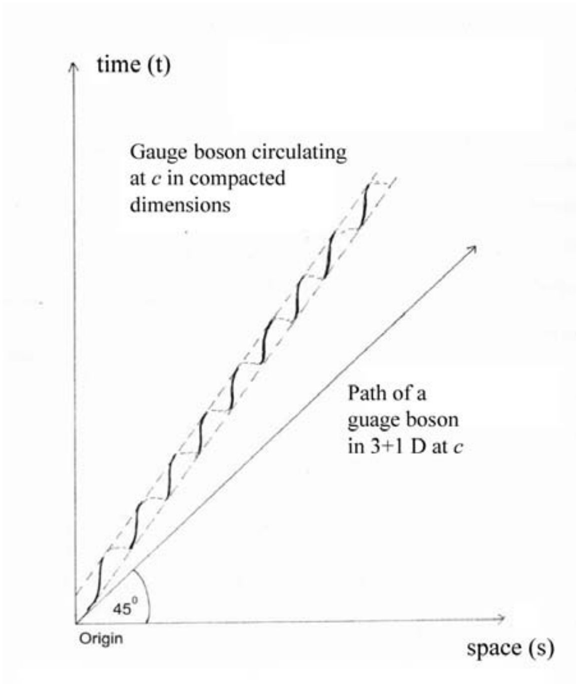

Figure 1 is a schematic representation of a gauge boson circulating within one compacted dimension. The effect can be likened to a spiral on a barber pole, continually returning to the starting place in terms of space, although at successively later times. A cross-section of the barber pole is just a circle (or ellipse), the simplest compact space orthogonal to everyday 3-space. In a three-plus-one-dimensional universe, force carriers are restricted to light-like paths at 45°. However, if compacted dimensions are involved, then while a force carrier travels at the speed of light—

10 Note: The barber pole leans over at angle arctan(v/c). If its radius were fixed, then the 45° spiral stripe (gauge boson path) would have a horizontal component greater than its vertical component—contrary to physics. However, the components remain equal if the barber pole cross-section contracts in the direction of motion as per Special Relativity (SR). If x and y are the two respective spatial dimensions and t is that of time, then we have:
v'x = (v – c sin(t)) / (1 – (v/c) sin(t)), and
v'y = c cos(t) √ 1–(v/c)2 / (1–(v/c) sin(t)),
such that $(v'x)^2 + (v'y)^2 = c^2$ as required.
This bears on the wavelength and thus the energy-momentum of the circulating gauge bosons in accord with $E = E_0 / \sqrt{1-(\nu/c)^2}$ where E_0 is the relevant absorption/emission energy in relation to a network at rest. (For further explanation of addition of velocities in SR, see Hartle, 2003, 71).

maintaining a spacetime interval of zero in a five-plus-dimensional spacetime—it may circulate within some network whose displacement entails some velocity less than *c*.

Figure 2: Network Trajectories of Gauge Bosons

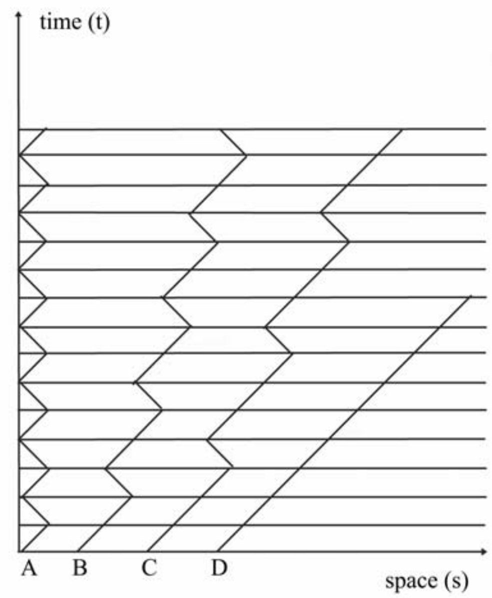

Figure 2 schematically shows how the velocity indicated by the lean of the barber pole varies depending upon how, relative to a frame of reference, gauge bosons travel through a one-dimensional compacted space. Barber pole A represents the path of a gauge boson through a network that is sitting still in space and persisting through time; B and C represent successively greater velocities; and for D the path is light-like.

3.3 Networks as Conserved Quantities

Conserved quantities are tied inextricably to fundamental force-fields, associated with gauge bosons. Theordore Kaluza and Oskar Klein (Kaluza, 1921, 971; Wuensch, 2003, 527) opened up the possibility of accommodating conserved quantities, like charge, spin and energy-momentum in terms of extra compacted dimensions. Light-like Network Theory suggests understanding conserved quantities in relation to *networks* of circulating force carriers.

Kaluza-Klein Theory demonstrated how charge would emerge directly from the existence of one suitably compacted dimension. Depending on the geometry and topology of the compacted dimensions, it may be feasible to account for all the conserved quantities, which give rise to fields of force. Take, for example, the idea of charge, as an 'energetic bit of the field' (Gribbin, 2007, 61). As John Griffin notes, we may picture an electron as some charged, confined region of the spacetime field embedded in a sea of virtual photons (Gribbin, 2007, 64). Calculations show that the electromagnetic field around an electron creates virtual photons that are constrained by the uncertainty principle such that they can move only half the distance of their wavelength before being reabsorbed.

Krauss describes what has previously been thought 'empty space' to be a brew of boiling, bubbling, 'particle-antiparticle pairs popping in and out of nothingness' (Krauss, 2005, 108-109). We could go further, however, to envisage non-virtual photons being emitted and absorbed from a circulation network of compacted dimensions. As Icke notes, 'the old problem: if an atom drops to a lower energy state and emits a photon, where was the photon before that? The answer…the photon was in another world, another "abstract space", and has become apparent at the juncture between the space(s) containing the single electron' (Icke, 1995, 182). LNT posits this 'other space' to be the micro-topological compacted dimensions.

In terms of the promised counter-argument: If an electron—representative of a fermion; the kinds of 'particles' most often associated with the manifestly qualitative world—were described as a set of conserved quantities partly constituted by a field of 'virtual' photons, this would be without recourse to anything categorical.

The story so far allows for fermions to be constituted from a pure power base, and from which we might build the manifestly substantial world. If so, a credible picture of fermions deriving from fundamental power completes the link between such a base and the world of our senses. Even without further analyse of such networks to show how they might interact to represent particles and more complex objects, one goal of the paper has been met, i.e. to present a counterexample to the Swinburne regress. Simply by demonstrating that if such networks existed, then they could plausibly correspond to fermionic entities, regress-type claims against the pure-power view are considerably weakened.[11]

3.4 So, explaining the Qualitative Manifest World *[slide click]*

The Swinburne regress and neo-Swinburne arguments claim that fundamental categorical properties are required for us to perceive the world we live in. Why? Because we are subject to an intuitively forceful distinction of the ontological status between arrangements of events in space (qualitative) and those in time (dispositional); that is, because we naturally perceive 'structure' in terms of spatial

[11] In this view, whereby fermions are ultimately 'made of' gauge bosons, the micro-topology must somehow account for bosonic whole-integer spin providing half-integer spin. Certain lines of speculation are open, but go beyond the scope of this paper.

definition. I conjecture that this is really a bias arising from the dimensional asymmetry of spacetime which sustains networks of gauge bosons that, detouring through micro-topological compacted dimensions, momentarily enter and exit everyday 3-space. Continually doing so across sufficiently short separations (in connection with Heisenberg's Uncertainty Principle[12]), we may suppose such constant circulation networks to be 'self-replicating' through time, thereby persisting.

'Concrete' particles thus arise from the continual self-replication of networks, clusters of which appear as fermionic matter. As self-sustaining spatial arrangements of conserved physical quantities, the resulting, apparent 'stuff' extends 'gratuitously' through time, upon which entropy imposes a well-defined direction.

Ultimately, however, we ourselves are likewise spatially confined networks (very complex barber poles), and therefore 'primed' by the expediency of self-preservation to perceptually encounter the world in terms of interacting with other particle-like networks, whose vectors give rise to the intuition of spatial primacy. The dimensional asymmetry of spacetime is thus translated into a bias toward identifying 'structure' as spatially located, categorical 'substance'.

3.5 Summary and Conclusion

Field fluctuations would otherwise travel along geodesic paths in 3-space, but the compacted, tangent spaces permanently circulate them through a multi-dimensional micro-topology whose local structure is influenced by the field fluctuation properties, perhaps primarily orientation, in a variety of specific spatiotemporal arrangements. The resulting networks are also force carrier absorbers and emitters. Any given

[12] $\Delta \rho \times \Delta s \leq$ Planck's constant. Shorter separations provide for greater uncertainty in momentum and other quantities, perhaps contributing to network stability.

network, which as a whole must travel slower than the speed of light, represents a concentration of energy-momentum with rest mass and other associated properties, identifiable by type such as some conserved quantity, e.g. charge.

If the existence of fermions, such as electrons—interpreted as charged regions of virtual photons—can be construed as manifestations of the field, so the field might be construed as ontologically prior to fermions. Consequently, at fundamental levels, there can be an absence of rest mass and pure spatial or pure temporal extension, and yet at supervening levels the appearance of massy networks gives rise to the manifestly qualitative world. Thus, Light-like Network Theory conforms to Rovelli's recognition that matter and spacetime cannot be fruitfully distinguished (Rovelli, 1997, 191-195); and Alexander Bird's claim that spacetime structure should be considered powerful (Bird, 2005a). Categorical objects could therefore be complex composites of fundamental field fluctuations that interact with respect to extra-dimensional orthogonalities. This would account for the manifested qualitative world in pure power terms, without fundamental categorical properties.

The ostensible spatial priority of the world obtains through spacetime's numerical asymmetry—several spatial dimensions versus one time dimension—permitting things to 'sit still' in space but not in time, and affording our intuitive attribution of different ontological status. Light-like Network Theory conjectures that the substantial objects of the world are actually complex, higher-order manifestations of pure power in the form of basic field fluctuations (force carriers) interacting in relation to extra, micro-topological orthogonalities. That is, the objects of the world, including ourselves, are very complex barber poles.

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